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(54) Crystallized, readily water-dispersible sugar product.

(57) A crystallized sugar product containing a food ingredient is prepared by concentrating a sugar syrup at a temperature in the range of about 250°F. to about 300°F. to a solids content of about 90 to 98% by weight, the sugar syrup containing no more than about 20% by weight non-sucrose solids, admixing the concentrated sugar syrup with a predetermined amount of the food ingredient, subjecting the admixture to impact beating within a crystallization zone until a crystallized sugar product made up of aggregates of fondant-size sucrose crystals and the food ingredient is formed, the crystallized sugar product having a moisture content of less than 2.5% by weight, and recovering the crystallized sugar product from the crystallization zone. The resulting sugar product is dry, granular, free-flowing, non-caking, and readily dispersible in water. The resulting sugar product may be either an intermediate food product, such as a gelatin concentrate, or an instant food product, such as an instant chocolate pudding mix, which contains all of the dry food ingredients for the final food product.

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CRYSTALLIZED, READILY WATER-DISPERSIBLE
SUGAR PRODUCT

Background of the Invention

5 This invention relates to a granular, free-flowing, non-caking sugar incorporated product. More specifically, this invention relates to a crystallized and readily water-dispersible sugar incorporated product and to a method for producing the sugar incorporated product.

10 Many food ingredients are sold by the food industry in powder or granular form. For example, gums, gelatin, emulsifiers, starches, cocoa and flavorants, which are used as thickening, stabilizing, gelling, coloring and flavoring agents in food products, are sold in powder form.

15 Food ingredients which are used in powdered form are not totally satisfactory. Because of their high affinity for water, these powdered food ingredients are not readily dispersed in water. The granules tend to clump together and float on the surface when they are mixed with liquids. In general, vigorous agitation while heating is needed to dissolve or disperse powdered food ingredients in liquids.

20 Other problems also exist with powdered food ingredients. Powdered food ingredients have a tendency to cake upon standing and an additive is needed to prevent this. Powdered food ingredients are mechanically blended. It is difficult to obtain a uniform blend

of the powdered food ingredients because they separate or settle out upon standing. Consequently, in order to use the correct proportions of ingredients in a package, the consumer must use the entire package rather than just a part of the package. Another problem is that a percentage of the blend components is lost as dust during mechanical blending.

"Instant" food products, that is, powdered food products which contain all of the food ingredients in a single package, encounter the same problems of difficulty of dispersion, tendency to cake, tendency to settle out, and dust losses.

It would be desirable to produce powdered food ingredients which avoid these problems.

It would also be desirable to produce instant food products which avoid these problems.

In the manufacture of sugar products, a process known as the transforming process is used to convert a sugar syrup into a dry sugar product. The sugar product is granular, free-flowing, non-caking, and is readily dispersed or dissolved in water. The transforming process has been described in U.S. Patents Nos. 3,149,682 (Tippens et al.), 3,365,331 (Miller et al.), 4,159,210 (Chen et al.), and our co-pending, co-assigned application entitled "Crystallized, Readily Water-Dispersible Sugar Product Containing Heat Sensitive, Acidic or High Invert Sugar Substances." In Tippens et al., the method comprises concentrating a sugar syrup to a

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solids content of about 95-97% by heating the sugar syrup to a temperature of about 250°-265°F.,
5 and subjecting the resulting supersaturated sugar syrup to a heat dissipation operation simultaneously with vigorous agitation. The method produces a dry sugar product comprising aggregates of fondant-size (3-50 microns) sucrose crystals. Miller et al.
10 describes a similar process in which impact beating is used to crystallize the sugar product from the supersaturated sugar syrup.

The feed syrup which is employed in the processes
15 of Tippens et al. and Miller et al. has a purity in the range of 85-97% by weight sucrose. Thus, the feed syrup may not contain more than about 15% by weight non-sucrose solids.

20 Both Tippens et al. and Miller et al. disclose that sugar products prepared in accordance with their invention are useful as carriers for additive materials which may have a food value or a taste value or a color value or medicinal value or the like.
24 The food additive may be added at any step in the process, such as during concentration, crystallization, comminution, screening, or by a separate blending and mixing operation with the sugar product, depending on the nature of the additive material.

30 Theoretically, it is possible to adapt the sugar transforming process so that a food ingredient is crystallized with the sucrose crystals from a sugar syrup containing the food ingredient. The resulting
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product would be granular, homogeneous, dry,
free-flowing and non-caking. In addition, because
5 the structure of the product would be porous clusters
of micro-sized sucrose crystals intimately associated
with the food ingredient, the food ingredient would
be readily dispersible or dissolvable in liquid.

10 Accordingly it is an object of this invention to
provide a product which incorporates a food ingredi-
ent into a crystalline sugar matrix.

It is also an object of this invention to provide
15 this sugar product in dry, granular, free-flowing,
non-caking form.

It is also an object of this invention to provide this
sugar product in a form in which the food ingredient
20 is readily dispersed or dissolved in liquid.

It is also an object of this invention to provide a
sugar product which contains all of the dry food
ingredients needed to make a final food product.
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It is also an object of this invention to provide
a method for preparing this sugar product.

30 These and other objects are accomplished by means of
the present invention described below.

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Summary of the Invention

5 By means of the present invention, a crystallized sugar product is prepared which incorporates a food ingredient into a sugar matrix. The product is homogeneous, dry, granular, free-flowing, and non-caking. The product is composed of agglomerates or aggregates
10 of minute, fondant-size sucrose crystals intimately associated with the food ingredient. Due to its porous structure, the crystallized sugar product is readily dispersed or dissolved in water.

15 The crystallized sugar product of the present invention is prepared by concentrating a sugar syrup at a temperature in the range of about 250°F. to about 300°F. to a solids content of about 90 to 98% by weight, said sugar syrup containing no more than
20 about 20% by weight non-sucrose solids; admixing the concentrated sugar syrup with the food ingredient; subjecting the mixture to impact beating within a crystallization zone until a crystallized sugar product made up of aggregates of fondant-size sucrose
25 crystals and the food ingredient is formed, the crystallized sugar product having a moisture content of less than 2.5% by weight; and recovering the crystallized sugar product from the crystallization zone. If desired, the resulting crystallized sugar
30 product may be dried to a moisture content of less than 1% by weight, followed by screening to a uniform size and packaging.

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Table II

| | <u>Cocoa Product</u> | <u>Cocoa Product</u> |
|----|---|-------------------------|
| 5 | | |
| | <u>Preparation Data</u> | |
| | Elevated Temperature | 255°F. 255°F. |
| 10 | Solids Content of Super-saturated Syrup | 95.0% 95.0% |
| | Crystallization Time Required | 175 Seconds 185 Seconds |
| | <u>Finished Product Analysis</u> | |
| 15 | Sucrose Content | 71.53% 71.69% |
| | Invert Sugar | 0.14% 0.16% |
| | Moisture Content | 0.82% 0.65% |
| | Cocoa Powder | 27.50% 27.50% |
| | <u>Screen Analysis (Tyler)</u> | |
| 20 | #14 | 2.4% 1.6% |
| | #35 | 3.2% 3.5% |
| | #60 | 46.5% 40.6% |
| | #100 | 31.8% 34.6% |
| | #150 | 12.4% 15.9% |
| 25 | #200 | 3.2% 1.4% |
| | Pan | 1.5% 2.4% |

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Table III

| 5 | <u>Gelatin Product</u> | | <u>Gelatin Product</u> |
|----|---|--------------|------------------------|
| | <u>Preparation Data</u> | | |
| | Elevated Temperature | 260°F. | 265°F. |
| 10 | Solids Content of Supersaturated Syrup | 95.0% | 96.5% |
| | Crystallization Time | 170 Seconds | 185 Seconds |
| | <u>Finished Product Analysis</u> | | |
| 15 | Sucrose Content | 88.53% | 78.31% |
| | Invert Sugar | 0.14% | 0.16% |
| | Moisture Content | 1.05% | 1.45% |
| | Gelatin Powder | 10% | 20% |
| | pH | 4.98 | 4.90 |
| 20 | Color (10% Solution) | 69 ASC Units | 73 ASC Units |
| | <u>Screen Analysis (Tyler)</u> | | |
| | # 14 | 2.4% | 1.6% |
| | # 35 | 3.2% | 3.5% |
| 25 | # 60 | 46.5% | 40.6% |
| | #100 | 31.8% | 34.6% |
| | #150 | 12.4% | 15.9% |
| | #200 | 3.2% | 1.4% |
| 30 | Pan | 1.5% | 2.4% |

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A wide variety of products may be prepared in accordance with the present invention. These products may be either intermediate food products or instant food products. By instant food products, it is meant that the product contains all of the dry food ingredients needed to make the final food. In contrast, intermediate food products, such as concentrates, must be blended with other food ingredients to make the food. In the preparation of intermediate food products or concentrates, it is desirable that the amount of food ingredient contained in the sugar incorporated product be equal to or less than the total amount of sugar in the syrup, i.e., the food ingredient should comprise about 0.05-50% by weight of the crystallized sugar product.

The following examples illustrate various embodiments of this invention but are not meant in any way to limit the scope thereof.

A dry, readily dispersible gelatin concentrate may be prepared in accordance with this invention. Desirably, the product contains about 0.5-30% by weight gelatin.

Example 1

A sugar solution of 65° Brix was heated to 255°F. to form a supersaturated syrup of approximately 95% solids content. An amount of gelatin equal to 10% by weight of the sugar was then added with controlled agitation (impact beating). Impact beating was continued until the mixture was converted into a substantially dry powder. As the crystallization of the sugar proceeded,

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the gelatin particles were incorporated into the sugar matrix of fondant-size sucrose crystals. The heat of crystallization which accompanied the reaction aided in removing moisture to give a substantially dry powdered product.

Example 2

10

A gelatin/sugar product was prepared as in Example 1 except that, instead of adding the gelatin to the supersaturated sugar solution, the supersaturated sugar solution was added to the gelatin with impact beating.

15

Impact beating was continued and crystallization proceeded, eventually resulting in the formation of a dry powdered product.

Example 3

20

1300 grams of sucrose solution (65° Brix) was heated to 265°F. to form a supersaturated syrup of approximately 97% solids. 200 grams of gelatin powder (through a Tyler #100 mesh screen) was added to the heated syrup with vigorous mechanical agitation using a Hobart mixer. Stirring was continued until the mixture was transformed and agglomerated into a dry powder. The finished product was screened through a Tyler #35 mesh screen.

30

Gelatin concentrates made in this manner were used in the formation of several food products containing gelatin, such as, mashmallow mix, stabilized icing mix, and gelatin dessert mix. The product was readily

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dispersed and dissolved in either hot or cold water and formed a firm gelled or stabilized product.

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In another embodiment of the present invention, various stabilizers, such as pectin, carrageenan, guar gum, agar-agar, xanthan gum, or sodium alginate may be incorporated into a crystallized sugar product. Desirably, the product comprises about 0.1-25% by weight of the solution.

10

Example 4

15 A sugar incorporated pectin was prepared in accordance with the process described in Example 3. This pectin concentrate was then used in the formulation of several food products, such as jelly mix, syrup spread mix, and beverage drink mix. The finished products possessed an instantly dispersing and dissolving nature when mixed with hot or cold water without any detectable lumping. They provided a firm gelled texture or a stabilizing or thickening property similar to that of products prepared by conventional processes.

20

25

In another embodiment, various emulsifiers, such as mono- and diglycerides, propylene glycol esters, sorbitan esters, polyoxyethylene sorbitan esters, lactylated esters, or lecithins, may be incorporated into a crystallized sugar product. Desirably, the product comprises 0.1-25% by weight of the stabilizer.

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Example 5

5 A sugar solution of 65° Brix was heated to 255°F. to
form a supersaturated syrup of approximately 95%
solids content. An amount of monoglycerol (Myverol
18-07, Kodak) equal to 5% by weight of the sugar was
then added with controlled agitation (impact beating).
10 Impact beating was continued until the mixture was
converted into a substantially dry powder. As the
crystallization of the sugar proceeded, the emulsifier
was incorporated with the fondant-size sugar particles
into a sugar matrix. The heat of crystallization
15 which accompanied the reaction aided in removing
moisture resulting in a substantially dry powdered
product. The finished product was screened through
a Tyler #35 mesh screen.

Example 6

20 An emulsifier/sugar product was prepared as in Example
5 except that the supersaturated sugar solution was
added to the emulsifier with impact beating. Impact
25 beating was continued and crystallization proceeded,
eventually resulting in the formation of a dry powder
similar to that of Example 5.

Example 7

30 A sugar incorporated monoglyceride product was prepared
according to the process described in Example 3. The
product prepared in this manner was used in the formu-
lation of several food products, such as, cake mix and
35 icing mix. The crystallized product, when added to

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cake mix or icing mix, provides excellent emulsion characteristics. For example, cake volume, porosity, and appearance, and icing stability and density were improved with the sugar incorporated emulsifier as compared with a conventional emulsifier.

In another embodiment, a cocoa or carob product may be prepared in accordance with the present invention. Desirably, the product comprises about 0.5-35% by weight cocoa or carob.

Example 8

A sugar solution of 65° Brix was heated to 255°F. to form a supersaturated syrup of approximately 95% solids content. An amount of cocoa powder (Hershey Challenge No. 100) equal to 25% by weight of the sugar solution was then added with controlled agitation. Stirring of the sugar solution and the cocoa powder resulted in the formation of a slurry and coating of the cocoa particles with the syrup. Stirring was continued until the mixture was converted into a dry powder. As the crystallization of the sugar proceeded, the cocoa powder particles were incorporated with the crystallized sugar. The heat of crystallization which accompanied the reaction aided in removing moisture and gave a substantially dry powdered product.

Example 9

A cocoa/sugar product was prepared as in Example 8 except that the supersaturated sugar solution was

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added to the cocoa powder with agitation to form a slurry, thereby coating the cocoa powder with the
5 syrup. Agitation was continued and crystallization was continued, eventually resulting in the formation of a dry powdered product similar to that of Example 8.

10

Example 10

580 grams of granulated sugar and 200 grams of brown sugar were dissolved in water and the solution heated until a product was obtained which contained 96%
15 solids. 200 grams of cocoa powder supplied by Hershey was added to the supersaturated syrup with agitation. Stirring was continued until the mixture was transformed into a dry powder. The finished product was then screened through a Tyler #35 mesh screen. The
20 sugar incorporated cocoa product was used in the formulation of several food products containing cocoa, such as chocolate milk drink and pudding. These products were readily dispersible in cold water without any evidence of lumping.

25

In another embodiment, various modified starches, such as, waxy maize starch, tapioca starch, corn starch, or wheat starch, may be incorporated into a crystallized sugar product. Desirably, the product comprises about
30 0.5-35% by weight starch.

Example 11

The modified starch (Stir-N-Set, National Starch)/sugar
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product was prepared according to the process described in Example 10. The sugar incorporated modified starch was used in the formulation of several instant food products containing starch, such as, pie filling, pastry filling, pudding, and spoonable salad dressings. This product was readily dispersible in cold water without mechanical agitation.

10

In another embodiment, various fibers, such as corn bran, soy hulls, beet pulps, or wood cellulose, may be incorporated into a crystallized sugar product. The fibers may be acidic, enzymatic, or oxidized modified such as alpha-cellulose, microcrystalline cellulose or other cellulosic fibers. Desirably, the product comprises about 0.5-35% by weight fiber.

15

Example 12

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A sugar solution of 65° Brix was heated to 255°F. to form a supersaturated sugar solution of approximately 95% solids content. An amount of alpha-cellulose (Paniplus, Keycel BH 200) equal to 25% by weight of the sugar solution was then added with controlled agitation. Stirring was continued until the moisture was converted into a dry powder. The incorporated product permits ready or instant dispersibility in liquid.

25

In another embodiment, various proteins, such as soy proteins, yeast proteins, milk proteins, wheat proteins, or egg proteins, are incorporated into a crystallized sugar product. The proteins may be acidic, enzymatic, or oxidized modified, such as, caseinates, lactalbumen,

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wheat gluten, or soy albumen. Desirably, the product comprises about 0.5-35% by weight protein.

5

Example 13

950 grams of granulated sugar and 50 grams of total invert sugar were dissolved in water and the solution was heated until a product was obtained which contained 96% solids. 300 grams of soy protein concentrates produced by Far-Mar, Inc. was added to the supersaturated sugar solution with agitation. Stirring was continued until the mixture was transformed into a substantially dry product. As the crystallization of the sugar proceeded, the soy protein particles were incorporated into the crystallized sugar. The heat of crystallization, which developed during the exothermic reaction, aided in removing moisture, resulting in a substantially dry particle.

10
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20

In another embodiment, various sugar substitutes, such as saccharin and its salts, aspartame (aspartyl-phenyl-alanine-methyl-ester), glycyrrhizin and its derivatives, cyclamate and its salts, miraculin (synsepalum dulsificum), sorbitol, mannitol, or xylitol, are incorporated into a crystalline sugar matrix. Desirably, the product comprises up to 50% by weight sugar substitute.

25

30

Example 14

A sugar solution prepared from 92% sucrose and 8% aspartame (dry weight basis) was heated to 260°F. to form a supersaturated syrup of approximately 93.5%

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solids content. The heated syrup was subjected to mechanical agitation (impact beating). Impact beating was continued until the mixture was transformed and agglomerated into a dry powder. As the transformation of the sugar proceeded, the synthetic sweetener cocrystallized with the fondant size sugar particles. The heat of crystallization aided in removing moisture, resulting in a substantially "dry" product. The finished product was screened to a uniform size through a Tyler No. 28 mesh screen. The cocrystallized product made in this manner was used as a low calorie sugar product. Assuming aspartame is 200 times as sweet as sucrose, 0.5 gram of the aspartame-sucrose product containing 2 calories provides the same sweetness as one teaspoonful (4.5 grams) of sugar containing 18 calories.

Example 15

The incorporation method used was the same as that described in Example 14. However, instead of an aspartame-sugar solution, a saccharin-sugar solution containing 99.8% of conventional brown sugar and 0.2% saccharin (dry weight basis) was used. The cocrystallized product has the same sweetness as sucrose with one-half the caloric content. The relative sweetness of saccharin was assumed to be 550 times that of sucrose.

Example 16

An instant chocolate pudding was prepared by dry blending the following ingredients:

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170.0 grams of pregelatinized starch
110.0 grams of cocoa powder (Hershey)
5 15.0 grams of tetrasodium pyrophosphate
8.0 grams of disodium phosphate
2.0 grams of monosodium phosphate
10.0 grams of calcium acetate
5.0 grams of non-fat dry milk solids.

10 480 grams of granulated sugar and 200 grams of brown
sugar were dissolved in 300 grams of water, and then
cooked to 265°F. The hot syrup was added to the
dry blend with agitation until complete crystalliza-
15 tion was obtained. The final product was screened
through a Tyler #35 mesh screen.

120 grams of this material dispersed instantly in two
cups of cold milk and produced a firm pudding after
20 10 minutes at refrigeration temperatures.

Example 17

An instant chocolate milk drink was prepared in accord-
25 ance with the present invention. 800 grams of granu-
lated sugar was dissolved in 300 ml. of water and then
heated to 270°F. The hot syrup was then added to 200
grams of carrageenan with agitation. The agitation was
continued until a dry granular product was obtained.
30 The finished product was screened through a #28 mesh
screen. 25 grams of this material dispersed rapidly
in one cup of cold milk and produced a chocolate milk
drink with good flavor and body.

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Example 18

5 An instant gelatin dessert mix was prepared by dis-
solving 800 grams of granulated sugar in 300 ml. of
water at 270°F. To this syrup was added 80 grams of
gelatin powder, 1 gram of citric acid, and 0.1 cc
of artificial strawberry flavor mix with agitation
10 to form a dry product. The finished product was
screened through a Tyler #28 mesh screen. 20 grams
of the finished product was easily dispersed with
slight agitation in one cup of cold water and produced
a good, firm gelled dessert after 2.5 hours of refri-
15 geration.

Example 19

20 An instant ice cream mix was prepared by dry blending
the following ingredients in a Hobart mixer:

350 grams of spray-dried butter
supplied by Borden
210 grams of non-fat dry milk solids
10 grams of stabilizer (sodium alginate)
25 0.5 grams of di- and monoglycerides
Coloring and flavoring (as desired).

440 grams of granulated sugar was dissolved in 350 grams
of water and heated to 270°F. The hot syrup was added
30 to the dry blend with agitation until complete crystal-
lization was obtained. 42.5 grams of this material
dispersed easily in 70 grams of cold water and produced
a stabilized ice cream after blending in a Waring
35 Blender and aging in a freezer.

Example 20

A chocolate sugar product was prepared by dry blending the following ingredients in a Hobart mixer:

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150 grams of cocoa powder
100 grams of milk solids
5 grams of pure vanilla powder
2 grams of caramel color.

10

753 grams of brown sugar was dissolved in water and heated to 265°F. The hot syrup was added to the dry blend with mechanical agitation until complete crystallization was obtained. The incorporated product has an instantly dispersible property when mixed with a liquid, such as cold milk.

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Example 21

20 A nutritional supplement was prepared by dry blending 45 grams of essential amino acids with 100.7 grams of partially hydrogenated soybean oil and emulsifier. 846 grams of brown sugar was dissolved in water and heated to 265°F. The hot syrup was added to the dry
25 blend with vigorous agitation until crystallization was complete. The sugar matrix acted as a carrier for the nutrients and resulted in a free-flowing, stable, non-perishable dry powder.

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Example 22

A dry cake base was prepared by dry blending 370 grams of cake flour, 130 grams of shortening, and 20 grams of dry milk. 426 grams of sugar was dissolved in water
35 and heated to 250°F. The supersaturated sugar syrup

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was then added to the dry blend with mechanical agitation until the sugar was transformed. The cake base
5 was mixed with other ingredients (egg white, baking powder, emulsifier and flavors) by dry blending to form a complete cake mix. Due to the formation of sugar/flour/fat agglomerates by the sugar transforming process, the cake prepared from this cocrystallized
10 mix has a higher volume (porosity) and better appearance than that prepared from a traditional dry blended product.

Example 23

15 A complete coffee beverage mix was prepared by dry blending 200 grams of instant coffee and 200 grams of non-dairy cream. 800 grams of sugar was dissolved in water and heated to 270°F. The supersaturated sugar syrup
20 was then added to the dry blend with mechanical agitation until the sugar was transformed. The incorporated product is a free-flowing, homogeneous, granulated powder with instantly dispersible property. A complete coffee drink can be prepared by reconstitution of 12
25 grams of this base with 1 cup of hot water. Similarly, a complete instant tea mix can also be produced in the same manner by incorporating instant tea powder and other ingredients into the sugar crystals.

30 All of the sugar incorporated products of the present invention are dry, granular, free-flowing, and non-caking. They are readily dispersible or dissolved in water. In addition, they are homogeneous and do not separate or settle out.

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While the invention has been described with reference
to specific embodiments, these were for purposes of
5 illustration only and should not be construed to
limit the scope of the present invention.

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WE CLAIM:

1. A method for preparing a crystallized sugar product containing a food ingredient, comprising:

(a) concentrating a sugar syrup at a temperature in the range of about 250°F. to about 300°F. to a solids content of about 90% to 98% by weight, said sugar syrup containing no more than about 20% by weight of non-sucrose solids;

(b) admixing the concentrated sugar syrup with a predetermined amount of the food ingredient;

(c) subjecting the admixture to impact beating within a crystallization zone until a crystallized sugar product is formed, said crystallized sugar product made up of aggregates of fondant-size sucrose crystals and the food ingredient and having a moisture content of less than 2.5% by weight; and

(d) recovering said crystallized sugar product from said crystallization zone.

2. A crystallized sugar product made in accordance with the method of Claim 1 wherein said food ingredient comprises, on a dry weight basis, about 0.05% to about 50% of the crystallized sugar product.

3. The crystallized sugar product of Claim 2 wherein food ingredient is gelatin.

4. The crystallized sugar product of Claim 2 wherein the food ingredient is cocoa or carob.

5. The crystallized sugar product of Claim 2 wherein the food ingredient is a protein.

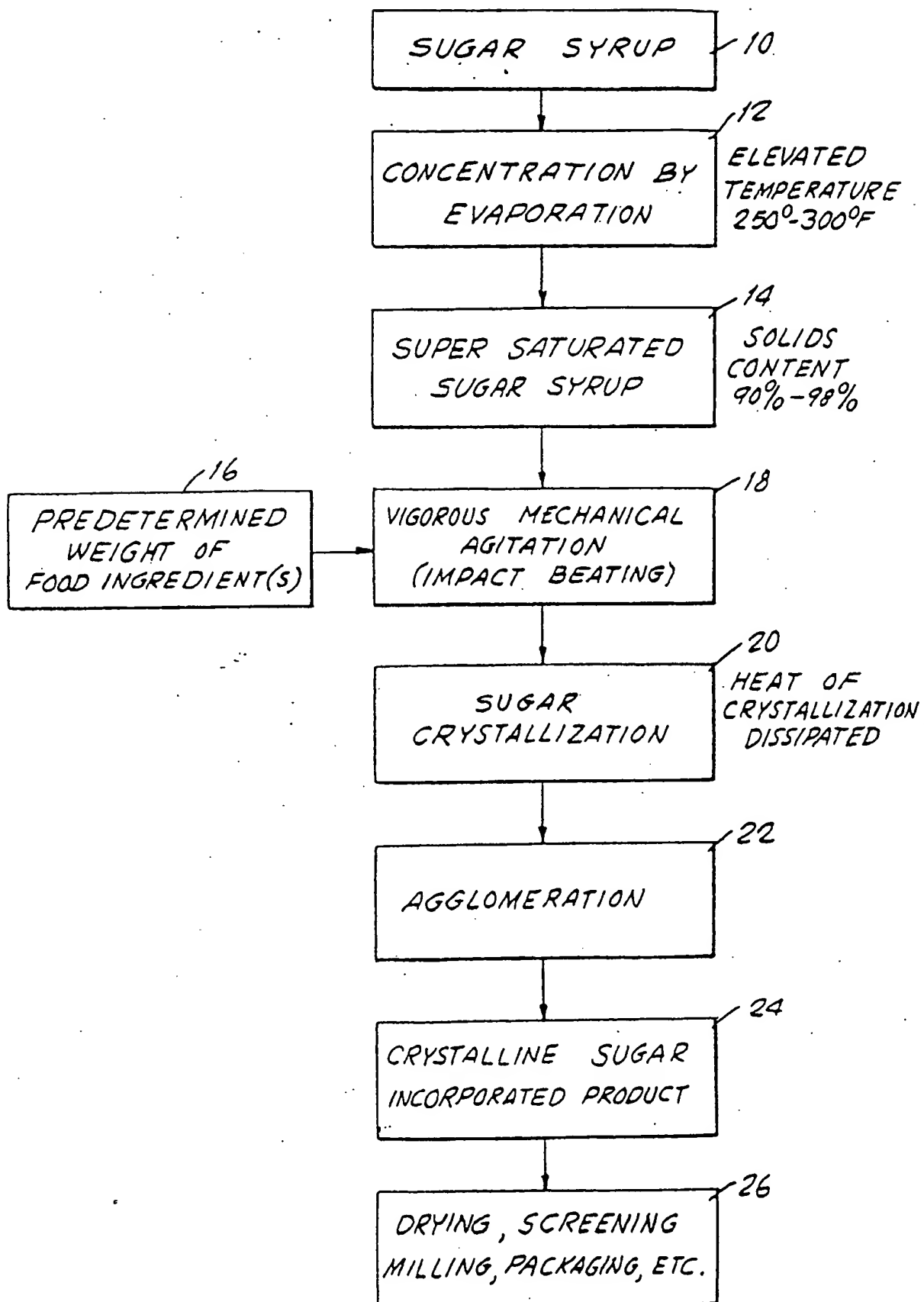
6. The crystallized sugar product of Claim 2 wherein the said food ingredient is a sugar substitute.

7. A crystallized sugar product made in accordance with the method of Claim 1 wherein said crystallized sugar product comprises an instant food product.

8. An instant chocolate milk product made in accordance with the method of Claim 1.

9. An instant gelatin product made in accordance with the method of Claim 1.
10. An instant ice cream product made in accordance with the method of Claim 1.
11. An instant chocolate sugar product made in accordance with the method of Claim 1.
12. An instan nutritional supplement made in accordance with the method of Claim 1.
13. An instant cake base made in accordance with the method of Claim 1.
14. An instant coffee or tea product made in accordance with the method of Claim 1.

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